

# APPLICATION UNDER UNITED STATES PATENT LAWS

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Invention: DIGITAL RECORDING/REPRODUCING APPARATUS

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This is a:

- ☐ Provisional Application
- ☒ Regular Utility Application
- ☐ Continuing Application  
☐ The contents of the parent are incorporated by reference
- ☐ PCT National Phase Application
- ☐ Design Application
- ☐ Reissue Application
- ☐ Plant Application
- ☐ Substitute Specification  
Sub. Spec Filed \_\_\_\_\_  
in App. No. \_\_\_\_\_ / \_\_\_\_\_
- ☐ Marked up Specification re  
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## SPECIFICATION

TITLE OF THE INVENTION

DIGITAL RECORDING/REPRODUCING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

5 This application is based upon and claims the benefit of priority from the prior Japanese Patent Application No. 2001-140276, filed May 10, 2001, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

10 1. Field of the Invention

The present invention relates to improvement of a digital recording/reproducing apparatus which uses a removable optical disc. The present invention relates particularly to a technique for eliminating intricacy regarding a recording setting associated with sound in a DVD recorder in which a plurality of types of sound languages (English, Japanese, and the like), a plurality of types of sound modes (monaural, dual-monaural, stereo, and the like) and a plurality of types of video formats (DVD video, DVD real-time recording, and the like) are supported.

2. Description of the Related Art

25 In recent years, an optical disc reproducing system in which audio-visual (AV) information including a dynamic image is recorded has been developed, and has generally spread for a purpose of movie software, karaoke, and the like. Above all, DVD video has

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remarkably spread. For a standard of DVD video, in accordance with a MPEG2 system layer, MPEG2 is supported in a dynamic image compression system, and AC audio and MPEG audio are supported in sound. Moreover, in the DVD video standard, sub image data in which bit map data is subjected to run length compression for subtitle and menu, and special control data (navigation pack) for special reproducing such as fast forward/rewind are defined. Furthermore, in the DVD video standard, ISO9660 and micro UDF (UDF bridge) are supported so that data can be read with a computer. As the standard of an information medium itself for storing AV information, following DVD-ROM as media for use in DVD video, standards of DVD-RAM (repeatedly readable/writable), DVD-R (write once), and DVD-RW (repeatedly rewritable) have been completed. Moreover, DVD-RAM drive (or DVD-R/DVD-RW drive) has also started to spread as computer peripherals.

At present, the standard of DVD-real-time recording (RTR) has been completed as DVD standard which utilizes DVD-RAM (or DVD-R/DVD-RW) and which is recordable/reproducible in real time, and a verification operation ended in spring, 2000. This standard is based on the standard of the presently spread DVD video (DVD-ROM). A file system for the DVD-RTR has also been standardized. Under these situations, DVD video recorder based on the DVD-RTR

standard has started to be on the market.

Many of DVD recorders now on the market support both formats of the DVD video and DVD-RTR. These are formats of the same DVD family. Unless both formats are supported, commercial property (appeal to a buyer layer) of DVD recorder is remarkably deteriorated.

However, even when both formats are supported, the formats have no correlation with respect to various initial settings, and settings are completely different. Therefore, even with the single recorder, a user needs to individually perform a similar setting with respect to both formats (in both modes). A problem occurs that the settings become intricate.

#### BRIEF SUMMARY OF THE INVENTION

In a digital recording/reproducing apparatus according to an embodiment of the present invention, a sound language setting in a second format (DVD-RTR) can be matched with the sound language setting in a first format (DVD video).

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. 1 is a block diagram showing the whole constitution of a digital recording/reproducing apparatus (DVD-RTR video recorder) with a sound changeover function according to one embodiment of the present invention.

FIG. 2 is a diagram showing a directory structure of an information file recorded by the apparatus of

FIG. 3 is a diagram showing a data structure of information (video object) recorded by the apparatus of FIG. 1.

FIG. 5 is a diagram showing a pack structure of audio information (linear PCM audio) recorded by the apparatus of FIG. 1.

FIG. 7 is a flowchart showing the whole operation of the apparatus of FIG. 1.

FIG. 9 is a flowchart of a recording operation in the apparatus of FIG. 1.

FIG. 11 is a flowchart of a setting processing of stream information (STI) in the apparatus of FIG. 1.

FIG. 13 is a flowchart showing the whole

reproducing operation (former half) in the apparatus of FIG. 1.

FIG. 14 is a flowchart showing the whole reproducing operation (latter half) in the apparatus of FIG. 1.

FIG. 15 is a flowchart showing a cell reproducing processing (former half) in the apparatus of FIG. 1.

FIG. 16 is a flowchart showing the cell reproducing processing (latter half) in the apparatus of FIG. 1.

FIG. 17 is a diagram showing contents of management information to be recorded by the apparatus of FIG. 1.

#### DETAILED DESCRIPTION OF THE INVENTION

A digital recording/reproducing apparatus (DVD-RTR recorder) according to one embodiment of the present invention will be described hereinafter with reference to the drawings. FIG. 1 is a block diagram showing a whole constitution of a digital recording/reproducing apparatus (DVD-RTR video recorder) with a sound changeover function according to one embodiment of the present invention. The apparatus basically performs real-time video recording using a recordable optical disc (DVD-RAM disc, DVD-RW disc, DVD-R disc) 100, and includes a reproducing function of an optical disc for exclusive use in reproducing (DVD-ROM disc, recorded DVD-R disc).

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The apparatus of FIG. 1 is constituted of: an encoder section 601; a decoder section 602; a main microcomputer (MPU) section 604; a video (V) mixing section 605; a frame memory 606; a key input section 607; a display 608; a DVD-RAM (and/or DVD-R/DVD-RW) drive 609; a data processor (D-PRO) 610; an A/V input 612; a TV tuner 613; an audio digital I/F 631; an audio D/A section 632; a speaker 633 (a driving audio amplifier is not shown); a video digital I/F 634; a TV D/A section 636; an external monitor TV 637; a system time counter (STC) 650; a temporary storage (large-capacity IC memory and/or HDD recorder unit) 700; a selector 750 of an audio signal; a bilingual broadcast detector (multilingual detector) 900; and the like.

A main MPU section 604 has therein a stream information (STI) setter 6044 and other control program (firmware). Moreover, the MPU section 604 has therein a work RAM 604a for use in executing the control program. A management information (VMG) holder 6043 is disposed in the work RAM 604a.

The encoder section 601 is constituted of an A/D section 614; a video encoder 616; an audio encoder 617 including a dual-monaural header setter 617a; a subpicture (SP) encoder 618; a formatter 619; and a buffer memory 620. Moreover, the decoder section 602 is constituted of a separator 625 including a memory

5           Recording (recording of AV information) is  
performed by the disc drive (DVD-RAM drive) 609, in  
which the removable DVD-RAM (or DVD-R/DVD-RW) disc 100  
is used, via the encoder section 601. The disc  
drive 609 can play back not only the DVD-RAM  
10       (or DVD-R/DVD-RW) disc 100 but also the DVD video  
      (or DVD-ROM) disc 100. That is, reproducing is  
performed using the disc drive 609 via the decoder  
section 602. The function of playing back the DVD  
video is basically the same as a DVD video player  
15       generally on the market.

A flow of an actual video signal in the apparatus of FIG. 1 is as follows. First, an analog AV signal inputted via the A/V input 612 or an analog TV signal obtained from the TV tuner 613 is converted to a digital signal in A/D section 614 of the encoder section 601. The video signal subjected to digital conversion is inputted to the video encoder 616, and the audio signal subjected to digital conversion is inputted to the audio encoder 617. Moreover, character broadcast data and other character data obtained from the TV tuner 613 are inputted to the subpicture (SP) encoder 618. The inputted video signal is MPEG



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Furthermore, the formatter 619 prepares respective segmenting information during recording (by interrupt in a top of GOP), and periodically sends the prepared

segmenting information to the MPU section 604.

Examples of the segmenting information include the number of packs of a video object unit (VOBU), end address of one picture from the top of VOB, reproducing time of VOB, and the like. Each VOB includes the video pack, and audio pack and/or subpicture pack. The information can be accessed by the unit of the VOB. Additionally, one video file is disposed in one disc in DVD-RTR (recording/reproducing DVD).

The TV broadcast signal is received by the TV tuner 613. The sound signal of the TV broadcast signal can have a plurality of sound modes. The sound signal received by the TV tuner 613 is, for example, monaural (L = R), stereo (L&R), or bilingual (multilingual), that is, dual-maural (L = main sound/Japanese, R = sub sound/foreign languages, and the like). The bilingual broadcast detector (multilingual detector) 900 detects whether or not the received sound signal is bilingual (multilingual), that is, dual-maural. The information detected by the bilingual broadcast detector 900 is inputted to the encoder section 601 and main MPU section, and subjected to various settings (described later with reference to flowcharts of and after FIG. 7).

FIG. 2 shows one example of a directory structure of an information file recorded by the apparatus of

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FIG. 1 (universal DVD-RTR recorder compatible with DVD video and other DVD family in reproducing). The video files of air check recording of TV broadcast is managed by a sub directory called DVD-RTAV. The directory  
5 DVD-RTAV includes a VMG file for storing management information (VR\_MANGR.IFO), a movie video file for storing dynamic image information (VR\_MOVIE.VRO), a still picture video file for storing still picture information (VR\_STILL.VRO), a still picture audio file  
10 for storing additional audio information (VR\_AUDIO.VRO) for a still picture, and a VMG backup file storing backup information (VR\_MANGR.BUP) of management information. Moreover, in DVD-RTR, one video file is stored in one disc. Furthermore, other audio files can  
15 be managed by a sub directory called AUDIO-TS.

FIG. 3 shows one example of a data structure of information (video object VOB) recorded by the apparatus of FIG. 1. A content of the file stored in the movie video file VR\_MOVIE.VRO of FIG. 2 is recorded  
20 as a group of one or more video objects VOB (video object set VOBS). Each VOB can be specified by a corresponding ID number (VOB\_IDNi). Each VOB is constituted of a group of one or more video object units VOBu. Each VOBu includes video data constituted  
25 of one or more groups of pictures of MPEG (GOP), and is constituted of real time data information (RDI) pack, video (V) pack, audio (A) pack, and the like. The V or



attribute V\_ART, number of audio stream AST\_Ns, number of subpicture stream SPST\_Ns, audio attribute A\_ART0 of stream #0, audio attribute A\_ART1 of stream #1, reserved area, and subpicture color pallet SP\_PLT.

5           The audio attribute A\_ART (each of A\_ART0 and A\_ART1) includes an audio coding mode (audio compression mode), application flag, quantizing DRC, sampling frequency fs, number of audio channels, bit rate information, and the like.

10           For the audio coding mode (audio compression mode), (a) "000b" indicates Dolby AC3 (R), (b) "010b" indicates MPEG1 or MPEG2 having no extension bit stream, (c) "011b" indicates MPEG2 having the extension bit stream, and (d) "100b" indicates linear PCM. Eight  
15       modes can be identified by three-bit audio coding mode, but modes other than (a) to (d) are reserved for the future.

          An application flag "00b" indicates that the corresponding audio stream includes audio data of  
20       a channel mode defined by "audio channel number", and "01b" indicates that the corresponding audio stream can include the audio data of a multi-channel mode (monaural, dual-monaural, and stereo). In the application flag "01b", "audio channel number" defines  
25       each mode of the corresponding audio stream.

          In the audio coding mode "000b", quantization/DRC is set to "11b". In the audio coding mode "010b" or

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"011b", quantization/DRC is set to "00b (no dynamic range control data in the MPEG audio stream)" or "01b (there is dynamic range control data in the MPEG audio stream)". In the audio coding mode "100b",  
5 quantization/DRC is set to "00b (16 bits)". Other audio coding modes are reserved.

For the sampling frequency  $f_s$ , "00b" indicates 48 kHz. Other sampling frequencies are reserved.

For the audio channel number, "0000b" indicates  
10 one channel (monaural), "0001b" indicates two channels (stereo), and "1001b" indicates two channels (dual-monaural). Moreover, "0010b" to "0111b" indicate multi-stereo (surround) or multi-monaural with three to eight channels. Here, when the audio coding mode  
15 (audio compression mode) is "100b (linear PCM)", two or less channel is set ("0000b", "0001b", or "1001b").

For the bit rate, 64 kbps to 384 kbps are set by "0000 0001b" to "0000 1011b" (for AC3 and MPEG1 audio). When the bit rate is "0000 1100b", 384 kbps is  
20 designated (for AC3). Moreover, with the bit rates "0000 1101b" and "0000 1110b", 768 kbps and 1536 kbps are designated, respectively (for linear PCM).

In summary, when the application flag is "00b", the corresponding audio stream is defined by the  
25 channel mode described in "audio channel number". When the application flag is "01b", the representative mode (monaural, dual-monaural, or stereo) of

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the corresponding audio stream is defined.

The same information as that of the "audio channel number" (monaural = "0000b", two channel stereo = "0001b", dual-monaural = "1001b") can be recorded in the data (header) of each audio stream. The audio channel number information is set in the audio decoder 630 of FIG. 1 at the start of reproducing. The audio decoder 630 decodes the audio stream reproduced with the set sound mode (monaural, stereo, or dual-monaural).

FIG. 5 shows a pack structure of audio information (linear PCM audio) recorded by the apparatus of FIG. 1. As shown in FIG. 5, one pack (2048 bytes) of the linear PCM (LPCM) is constituted of a pack header, packet header, sub stream ID, and LPCM data. The packet header includes stream ID = 0xbd (or "1011 1101b") indicating a private stream 1. Moreover, sub stream ID is "1010 000\*b" indicating the linear PCM. Here, \* denotes an audio stream number (0 or 1).

The LPCM data subsequent to the sub stream ID includes audio frame information, audio data information, and data main body of LPCM. Moreover, the audio data information can store "audio channel number" information (monaural = "0000b", two-channel stereo = "0001b", dual-monaural = "1001b").

TV broadcast recording of bilingual broadcast can be indicated by "audio channel number" = "1001b"

indicating the dual-monaural mode.

FIG. 6 illustrates a pack structure of audio information (MPEG audio) recorded by the apparatus of FIG. 1. As shown in FIG. 6, one pack (2048 bytes) of MPEG audio is constituted of a pack header, packet header, and MPEG audio data. This packet header includes stream ID = 0(c0 (or "1100 000\*b") indicating MPEG audio or 0(d0 (or "1101 000\*b"). Here, \* indicates audio stream number (0 or 1). For the MPEG audio, there is no sub stream ID.

The MPEG audio data subsequent to the packet header includes a plurality of audio access units (AAU) as a unit of audio decode. Here, AAU is a minimum unit which can individually be decoded to the audio signal), and constantly includes data having a constant sample number. Each AAU includes an error check code and audio data. The header includes a synchronous word, ID information, layer information, ..., mode information, and the like. (Other information such as a protection bit, bit rate index, sampling frequency, padding bit, and private bit are disposed before the mode information. Moreover, mode expansion information, copyrights information, original or copy information, and emphasis information are disposed after the mode information.)

The mode information is constituted of two bits, "00b" indicates stereo, "01b" indicates joint stereo,



"10b" indicates dual channel (dual-monaural), and "11b" indicates single channel (monaural). The mode information is "10b" indicating dual-monaural in bilingual broadcast recording. During playback  
5 (or reproduction) of the disc after recording, the audio decoder 630 of FIG. 1 reads the mode information, and the mode is automatically changed to a mode (dual-monaural decode mode designated by "10b") designated by the content of the read mode information.

10 Various operations of the apparatus of FIG. 1 will next be described with reference to a flowchart. FIG. 7 is the flowchart showing the whole operation of the apparatus of FIG. 1. Each processing of the flowchart is controlled by the main MPU section 604  
15 of FIG. 1. The main MPU section 604 executes a predetermined initial setting (step ST10) after starting the apparatus. Thereafter, key input from a user (key input from a remote controller (not shown) or operation command from reserving/recording program)  
20 is waited for. When there is a key input (step ST20), the input key is interpreted (changeover command of TV received channel, recording start command, reproducing start command, and the like) (step ST30).

25 When the input key is interpreted as "the changeover command of TV received channel", a processing of changing the received channel of the TV tuner 613 is performed (step ST40). The processing of

changing the received channel includes not only  
a channel changing in the same broadcast band (e.g., 1  
to 12 ch of VHF band) but also a channel changing over  
different broadcast bands (e.g., VHF 1 ch to BS digital  
103 ch).

When the input key is interpreted as "recording  
start command", the recordable optical disc (DVD-RAM  
disc, and the like) 100 inserted to the disc drive 609  
is subjected to a recording processing (step ST50).

When the input key is interpreted as "reproducing  
start command", a reproducing processing from the  
optical disc (DVD-RAM disc, DVD-RW disc, DVD-R disc, or  
DVD video disc) is performed (step ST60).

FIG. 8 is a flowchart of an operation for  
selecting a broadcast program in the apparatus of  
FIG. 1. Here, it is assumed that a sound language for  
use in default is stored beforehand in the work RAM  
604a (or a not-shown data storing memory) regarding  
playback of DVD video by the apparatus of FIG. 1.

First, a channel change command from the user (or  
reserving/recording program) is issued to the TV tuner  
613 (step ST400). The TV received channel is changed  
in accordance with the received command in the TV tuner  
613 (e.g., the present TV received channel VHF 1 ch is  
changed to VHF 3 ch).

The sound mode of TV broadcast received by the TV  
tuner 613 after changing of the received channel is,



The user judges that the sound mode of the TV broadcast is to be tuned to the audio language (e.g., English) for the DVD video (yes in step ST408). In this case, the main MPU section 604 checks the language code for use in the DVD video from a parameter table (not shown) for the DVD video stored in the work RAM 604a. When the language code is, for example, English, the sub sound (English) of the received TV channel is distributed and outputted to two channels (L = R) (step ST412). Alternatively, when the language code is Japanese, the main sound (Japanese) of the received TV channel is distributed and outputted to the two channels (L = R) (step ST412).

Additionally, a case in which the language code  
for present use in the DVD video is the same as the  
language of the subsound of bilingual broadcast has  
been described above. However, when the language code  
for present use in the DVD video is different from the  
language of the subsound of bilingual broadcast,  
several variations are considered in processing methods  
of steps ST408 and ST412.

the DVD video is other than Japanese (e.g., German),  
and even when the language of the subsound is any  
language (e.g., English, German, or French), there is  
a method of distributing and outputting the subsound to  
5 two channels (L = R). This method is not suitable for  
a case in which the MPU section 604 cannot obtain the  
information for specifying the type of the subsound  
language of the received bilingual broadcast.

Alternatively, when the language setting of the  
10 DVD video is English, there is a method of distributing  
and outputting the subsound (any language) to two  
channels (L = R). This method is suitable for  
distributing and outputting the subsound of any foreign  
language (there is usually a highest possibility of  
15 English) to two channels (L = R).

As described above, when the sound language  
setting of the DVD video is reflected in setting of  
recording/reproducing of DVD-RTR, a digital  
recording/reproducing apparatus (DVD-RTR recorder) can  
20 be realized without intricacy of setting.

FIG. 9 is a flowchart of a recording operation in  
the apparatus of FIG. 1. The main MPU section 604  
reads each file system data from the disc 100 inserted  
in the disc drive 609 (step ST500). A used capacity is  
25 calculated from the read data, and it is checked  
whether or not there is a free space (or a vacant  
capacity) in the disc 100. When there is no free space

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information (yes in step ST516), the segmenting  
information is extracted from the formatter 619 (step  
ST518). In other words, the image and sound signals  
taken into the encoder section 601 is A/D converted,  
5 respectively, and compressed by the encoders 616, 617.  
When a constant amount (one CDA) of compressed data is  
accumulated (yes in step ST512), the data is recorded  
in the disc 100. In this case, the segmenting  
information of the compressed data is taken into the  
10 work RAM 604a (step ST518). During recording (no in  
step ST520), the processing of steps ST512 to ST518 is  
repeated.

When the recording ends (yes in step ST520),  
a recording end processing is executed (step ST530).  
15 In the recording end processing, the remaining  
segmenting information is taken from the formatter 619  
and initialized, and setting of program chain  
information PGC1 (segmenting information, I-picture  
information, and the like) is written into the  
20 management information VMG. In other words, the  
remaining segmenting information is taken into the work  
RAM 604a, and the management information VMG is updated  
based on the taken segmenting information. In this  
case, the sound mode having a largest number of packs  
25 in recording is recorded in stream information STI  
(M\_VOB\_STI# of FIG. 4) in accordance with the sound  
mode (monaural, dual-monaural, or stereo) of the

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segmenting information (STI setting processing described later with reference to FIG. 11). Generally speaking, the stereo sound mode is most in TV recording of a music program, and the dual-monaural mode is not in TV recording of foreign movie with Japanese subtitles.

FIG. 10 is a flowchart of an interrupt processing in the apparatus of FIG. 1. In the interrupt processing, there are various factors for an interrupt, and first the interrupt factors are checked (step ST70). When the interrupt factor is, for example, "interrupt processing at the end of transfer of one pack to D-PRO 610", an interrupt processing Recpack++ for counting up the number of recording packs is executed (step ST72). Moreover, when the interrupt factor is, for example, "interrupt processing during extracting of segmenting information from formatter 619", an interrupt flag for extracting segmenting information 1 is set (step ST74). As not shown, an interrupt flag for extracting segmenting information x (x = 1, 2, 3, ...) is appropriately performed. After the interrupt processing for each interrupt factor is performed as described above, the processing returns to another flow of processing.

FIG. 11 is a flowchart of a setting processing of stream information (STI) in the apparatus of FIG. 1. This processing is executed as a part of step ST530 of



FIG. 9. First, a state (monaural, dual-monaural, or stereo) of the sound mode during recording is checked from the segmenting information taken into the work RAM 604a (step ST5300). The sound mode having a largest  
5 number of recordings is checked among the checked sound modes (step ST5302). When the monaural sound mode has the largest number of recordings, the "audio channel number" of the stream information STI (M\_VOB\_STI# of FIG. 4) is set to "monaural: 0000b" (step ST5304).  
10 When the dual-monaural sound mode has the largest number of recordings, the "audio channel number" of the stream information STI is set to "dual-monaural: 1001b" (step ST5306). When the stereo sound mode has the largest number of recordings, the "audio channel  
15 number" of the stream information STI is set to "2 ch stereo: 0001b" (step ST5308).

FIG. 12 is a flowchart of an encoding processing of audio data in the apparatus of FIG. 1. First, the main MPU section 604 reads attribute information (A\_ATR  
20 of FIG. 4) of a sound A/D converted and taken into the encoder section 601 from the TV tuner 613 (step ST5400). The sound mode is checked from the content of the read attribute information ("audio channel number") (step ST5402). When the sound mode is monaural,  
25 monaural is set in the header of a sound stream (FIG. 6) (step ST5404). When the sound mode is dual-monaural, dual-monaural is set in the header of

the sound stream (step ST5406). When the sound mode is stereo, stereo is set in the header of the sound stream (step ST5408). After the information of the sound mode is set in the header of the sound stream, a compression processing of the sound data (e.g., compression processing of MPEG audio) is executed (step ST5410). Additionally, when the sound data is recorded as linear PCM, setting of steps ST5404 to ST5408 is performed with respect to the "audio channel number" of FIG. 5, and the processing of step ST5410 corresponds to linear PCM encoding.

FIGS. 13 and 14 are flowcharts showing the whole reproducing operation in the apparatus of FIG. 1. First, reading is started from lead-in of the disc 100 inserted in the disc drive 609, and it is checked whether or not the disc is normally read (step ST600). The disc is not normally read and it is judged that the disc 100 has a problem (NG in step ST600). Then, an error processing (displaying of error in the display 608 and/or the TV 637) is performed (step ST602), and the reproducing processing ends. On the other hand, the disc 100 can normally be read (OK in step ST600), and it is then checked whether or not the information of a volume structure is recorded in the disc 100 (step ST604). When the volume structure is not recorded (no in step ST604), "not recorded" is displayed in the display 608 and/or the TV 637

When the volume structure is recorded (yes in step ST604), presence/absence of the directory of DVD-RTR (DVD-RTAV in FIG. 2) is checked in a recorded hierarchy file (step ST608). If there is no DVD-RTR (DVD-RTAV) directory (no in step ST608), "not recorded" is displayed (step ST606), and the reproducing processing ends. If there is DVD-RTR (DVD-RTAV) directory (yes in step ST608), the presence/absence of the error is checked (step ST610). If there is an error (yes in step ST610), "error has been found in file system" is displayed in the display 608 and/or the TV 637 (step ST612) and the reproducing processing ends.

When VRO file (VR\_MOVIE.VOR of FIG. 2, and the like) is not recorded in the read VMG directory (no in

step ST620), "not recorded" is displayed (step ST616) and the reproducing processing ends. when the VRO file is recorded in the read VMG directory (yes in step ST620), a program chain to be reproduced (original PGC, user-defined PGC#1, user-defined PGC#2, and the like) is determined (step ST622). Subsequently, the content of the stream information STI (any one of M\_VOB\_STI#1 to #n) in VMG read in step ST618 is read, and the MPEG video decoder 628, subpicture decoder 627, and audio decoder 630 of FIG. 1 are subjected to the initial setting (step ST624). This continues to <node A> of FIG. 14.

The stream information STI read in step ST624 includes the audio attribute information A\_ATR (see FIG. 4) which has the "audio channel number". The main MPU section 604 of FIG. 1 checks whether or not the sound mode of the title to be reproduced is "bilingual" (i.e., whether or not "audio channel number" is "1001b" indicating the dual-monaural mode) based on the content ("audio channel number") of the stream information STI (step ST626). With the bilingual mode (yes in step ST626), it is further checked whether or not the audio language code of the DVD video is to be followed (step ST628).

When the code is followed (yes in step ST628), the audio language code of the DVD video (set by the user during initial setting, e.g., English) is read from

the work RAM 604a, and the subsound (English) of the bilingual mode is selected in accordance with sound language code (English). The audio decoder 630 is set so that the selected subsound is outputted via both channels (L/R) (step ST630). When the code is not followed (no in step ST628), the sound (e.g., Japanese main sound or English sub sound) designated for reproducing of DVD-RTR by the user via GUI is selected from the sound of the recorded TV channel. The audio decoder 630 is set so that the selected subsound is outputted via the both channels (L/R) (step ST632). When the sound mode of the title to be reproduced is stereo (no in step ST626), the processing of steps ST628 to ST632 is slipped. Then, the audio decoder 630 is set so that the recorded stereo sound is outputted via the both channels (L/R).

After the audio decoder 630 is set as described above, a cell reproducing processing (step ST640) is performed. During reproducing (no in step ST642), the next cell is set in accordance with the program chain information PGCI (original PGCI or user-defined PGCI) in the VMG file (step ST644). In this case, when the sound mode changes (to the stereo mode from the dual-monaural mode), and the setting of audio decoding is changed (yes in step ST646), the setting of the audio decoder 630 is changed by the next sequence end code (step ST648). When the setting of the audio decoding

is not changed (no in step ST646), the setting of step ST648 is not changed. When the reproducing continues to the next cell in a seamless mode (yes in step ST650), the processing returns to the cell reproducing processing of step ST640. When the reproducing continues to the next cell in a non-seamless mode (no in step ST650), the MPEG decoder is set to a free run mode, a seamless connection flag (not shown) is set (step ST652), and the processing returns to the cell reproducing processing (step ST640).

After the cell reproducing ends (yes in step ST642), the error is checked (step ST660). When there is no error (no in step ST660), the other processing for ending the reproducing is executed (step ST662), and the reproducing processing of FIGS. 13 and 14 ends. When the error occurs at the end of reproducing (yes in step ST660), "read error occurs" is displayed in the display 608 and/or the TV637 (step ST664), the reproducing end processing (step ST666) is executed, and the processing returns to other processing state (e.g., the key input waiting state of step ST20 of FIG. 7).

Additionally, the processing of steps the ST626, ST628, ST630 and ST632 of FIG. 14 corresponds to the processing of steps ST404, ST408, ST412 and ST410 of FIG. 8.

FIGS. 15 and 16 are flowcharts showing one example



the VOB is checked. When there is RDI pack (FIG. 3) in the top of VOB (yes in step ST6418), and there is a change in aspect ratio (yes in step ST6420), a direct-current component of a chromatic signal (C signal) outputted via video terminal S after decoding is appropriately changed (step ST6422). This continues to <node B> of FIG. 16.

When the seamless connection flag (set in step ST652 of FIG. 14) in the VOB data read in step ST6416 is set (yes in step ST6424), "read FP+read length" is set as read FP, and MPEG decoder is set to a normal mode. Moreover, a system clock reference SCR is appropriately read and set, and the seamless connection flag is reset (step ST6426).

When the transfer started in step ST6412 of FIG. 15 does not end (no in step ST6428), there is a key input in step ST20 of FIG. 7 (yes in step ST6430), and a special reproducing mode is fast forward FF (yes in step ST6432), a jump direction for the fast forward is set to a positive direction, and a read position read\_fp is set in accordance with the jump amount (step ST6434). On the other hand, when a special reproducing mode is not the fast forward FF but a fast rewind FR (no in step ST6432, yes in step ST6436), the jump direction for the fast rewind is set to a negative direction, and the read position read\_fp is set in accordance with the jump amount (step ST6438).



When the read position read\_fp during FF or FR operation, a processing of contiguous data area DCA for the special reproducing (FF or FR) is performed (step ST6440), and the processing returns to step ST642 of FIG. 14.

5 Additionally, in DCA processing of step ST6440, the read position read\_fp can be determined based on the time map information TMAPI referred to in step ST6400 of FIG. 15 in consideration of the jump amount. 10 Moreover, if there is no key input (no in step ST6430), or even if the key input is neither FF key nor FR key (no in step ST6432, no in step ST6436), the processing returns to step ST6414 of FIG. 15 via <node C>.

When the transfer started in step ST6412 of FIG. 15 ends (yes in step ST6428), and the remaining cell length is zero (yes in step ST6450), this is an end of the cell. Therefore, the processing of FIGS. 15 and 16 ends, and the processing returns to step ST642 of FIG. 14. When the remaining cell length is not zero 15 (no in step ST6450), the processing returns to step ST6420 of FIG. 15 via <node D>.

20 Additionally, in the aforementioned embodiment, "the setting which is associated with the language of the sound already set in DVD video reproducing" is automatically reflected in setting of DVD video 25 recording. As expansion/modification, "the setting which is associated with the language of the set sound"

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a volume & file management information and a data area of user data (AV information or the like). As shown in FIG. 17(c), the data area can record management information RTR\_VMG and contents (video object VOB constituting the AV information, or the like ) of the user data. Management information RTR\_VMG is stored as a file of video manager VMG.

Management information RTR\_VMG includes, as shown in FIG. 17(d), RTR video manager information RTR\_VMGI, movie AV file information table M\_AVFIT, still picture AV file information table S\_AVFIT, original program chain information ORG\_PGCI, user-defined program chain information table UD\_PGCIT, text data manager TXTDT\_MG, and manufacturer's information MNFIT.

Incidentally, program chain information PGCI has a data structure representing a whole reproduction of program chain PGC, and the PGC represents a sequence of program PG (or a program set). The PG is a logical unit of the recorded contents. The PG is recognized or defined by a user. The PG in a program set is formed of one or more original cells (which are reproduction units of the initial recorded contents), and the PG is defined only within the ORG\_PGCI. In other words, the ORG\_PGCI is the information by which an order of reproduction of cells corresponding to the initial recorded contents is described. On the other hand, the UD\_PGCIT denotes a table which describes one or more

The M\_AVFIT includes, as shown in FIG. 17(e), movie AV file information table information M\_AVFITI, one or more pieces of movie VOB stream information M\_VOB\_STI#1 to M\_VOB\_STI#n, and movie AV file information M\_AVFI. The M\_AVFI includes, as shown in FIG. 17(f), movie AV file information general information M\_AVFI\_GI, one or more movie VOB information search pointers M\_VOBI\_SRP#1 to M\_VOBI\_SRP#n, and pieces of movie VOB information M\_VOBI#1 to M\_VOBI#n corresponding in number to the number of the search pointers.

The TMAPI includes, as shown in FIG. 17(h), time map general information TMAP\_GI, one or more time entries TM\_ENT#1 to TM\_ENT#r, and one or more VOBU ENT#1 to VOBU ENT#q.

Each TM\_ENT includes, as shown in FIG. 17(i),  
VOBU ENTN indicating the corresponding VOB entry

number, TM\_DIFF indicating a time difference between the playback start time of the VOB being designated by the time entry and the calculated playback time, and VOBU\_ADR indicating the address of the target VOB.

5 In the NTSC, when a time unit TMU is represented by 600 fields (or in the PAL, when the time unit TMU is represented by 500 fields), the above-mentioned "calculated playback time" with respect to the time entry #j can be represented by  $TMU \times (j-1) + TM\_OSF$ .

10 The VOBU\_ADR represents the target VOB address by the total size of the preceding VOB's of the VOB wherein the size of the VOB is expressed in unit of a sector.

According to the data structure as exemplified above, when a playback has to be started from an intermediate point of a VOB, it is necessary to determine its access point. This access point is called a time entry point. The time entry point is located at a place being deviated from the position, indicated by the movie address information of the VOB, by the time difference, indicated by the time difference information TM\_DIFF in the time entry TM\_ENT. This time entry point is a specific playback start point (or time search point) indicated by the time map information TMAPI.

25 Each VOB entry includes, as shown in FIG. 17(i), reference picture size information 1STREF\_SZ, VOB playback time information VOB\_PB\_TM, and VOB size

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information VOBUSZ. Here, the VOBUPB\_TM indicates the playback time of the corresponding VOBU in unit of a video field. The reference picture size information 1STREF\_SZ indicates the size of the first reference picture (corresponding to an I-picture of the MPEG) in the corresponding VOBU in unit of a sector.

Incidentally, in the VOBU entry, the "time interval of VOBUs" is represented by the number of fields. However, as another method, the "time interval of VOBUs" may be represented by the count value of a clock counter, the count value indicating the interval from one VOBU to the next VOBU. More specifically, the "time interval of VOBUs" may be represented by the differential value of the "presentation time stamp PTS at the leading point of one VOBU" and the "PTS value at the leading point of the immediately followed VOBU." In other words, it is possible to represent the time interval in a specific unit by the differential value of clock counts within that unit.

As described above, according to the digital recording/reproducing apparatus of the present invention, the setting associated with the language of the sound (already completed) is reflected in setting of recording/reproducing of DVD-RTR, and setting intricacy can be solved.

Additional advantages and modifications will readily occur to those skilled in the art. Therefore,

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the invention in its broader aspects is not limited to  
the specific details and representative embodiments  
shown and described herein. Accordingly, various  
modifications may be made without departing from the  
5 spirit or scope of the general invention concept as  
defined by the appended claims and their equivalents.

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